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Journal watch

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Support Recovery with Orthogonal Matching Pursuit in the Presence of Noise

- Jian Wang, Nanjing University China
- Bounds on the minimum SNR requirements of OMP are derived
- Two cases considered
  - SNR scales linearly with the sparsity order
  - Fixed SNR
- It is shown that the support may be exactly recovered if

$$\sqrt{SNR} > \frac{2\sqrt{K}(1+\delta_{K+1})}{1-\left(\left(\sqrt{K}+1\right)\delta_{K+1}\right)\sqrt{MAR}}$$

and only if

$$\sqrt{SNR} > \frac{\sqrt{K}(1+\delta_{K+1})}{1-\left(\sqrt{K}\delta_{K+1}\right)\sqrt{MAR}}$$

- Such that

$$MAR = \frac{\min_{j \in supp(\boldsymbol{x})} \left|x_j\right|^2}{\frac{\|\boldsymbol{x}\|_2^2}{K}}$$

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and

$$\delta_{K+1} = 1 - \frac{t}{\sqrt{K+1} + t}$$

$$t = \frac{2\sqrt{K}}{\sqrt{SNR \times MAR}}$$

- The minimum SNR required for recovery is therefore unbounded from above
- Proved by induction
- Exact recovery not possible for fixed SNR case, instead,
- If

$$\sqrt{SNR} > \frac{\kappa}{\delta_{2K}^{3/4}}$$

with $\kappa = \max_{i,j} \frac{|x_i|}{|x_j|}$

then OMP can recover the support of a K-sparse signal with an error rate

$$\rho_{error} \leq C\kappa^2 \delta_{2K}^{\frac{1}{2}}$$

Restricted Isometry Property on Banded Block Topelitz Matrices with Application to Multi-Channel Convolutive Source Separation

- Dehghan; Dansereau; Chan, Carleton University ON, Canada
- Banded Toeplitz matrices offer faster matrix multiplications reducing the computational complexity of the recovery algorithms
- Convolutive systems are shown to generate signals with a Topelitz structure
- It is shown that Banded Topelitz Matrices satisfy RIP with high probability
- These are shown to be a special case of sparse matrices with a circulant structure
- An application to multichannel source separation is considered.
- An upper bound in the form of the RIP bound for sparse Gaussian matrices.

Power Constrained Sparse Gaussian Dimensionality Reduction over noisy channels

- Shirazinia and Dey, Uppsala University, Sweden
- Single and multiple receive terminals are considered, with the multi-terminal case considering orthogonal channels for different users
- MSE of the source and reconstructed vectors is used as a design criterion for the sensing matrix
- The design procedure involves minimizing the lower bound on MSE in a single and multi-terminal setup
- Three stage optimization scheme consisting of semidefinite relaxation, low rank approximation and power scaling is proposed and found to significantly improve the performance.
- This performance improvement comes at the cost of increased computational complexity.
- A stochastic approximation method is used to reduce computational complexity

Dynamic Spectrum Access and Power Allocation for Cooperative Cognitive Radio Networks

- Zou; Wu; Xiong; Chen, Shanghai University, China
- Cooperative CRNs considered, where the PUs are aware and supportive of SUs.
- Conventional cooperative CRNs allow SUs to use primary bands in return for relaying their data
- Here primary bands are auctioned by the PUs as they are assumed to be capable enough of meeting their rate requirements
- The time frame consists of two slots with a fraction reserved for the PU and another available for auction
- Slot lengths are determined by the available resources and rate requirements of PUs.
- The SU may choose direct communication or may choose the PU transmitter to act as a relay.
- Prices of power and bands are determined by the ascending clock auction algorithm

Other Interesting Papers

- Xaver, F., "Mixed Discrete-Continuous Bayesian Inference: Censored Measurements of Sparse Signals"
- Lan Jiang; Singh, S.S.; Yildirim, S., "Bayesian Tracking and Parameter Learning for Non-Linear Multiple Target Tracking Models"
- Ait-El-Fquih, B.; Hoteit, I., "Fast Kalman-Like Filtering for Large-Dimensional Linear and Gaussian State-Space Models"